

**DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD**

U.S. Coast Guard MHM-
2/83
400 Seventh Street, SW
Washington, DC 20590

NVC 6-71
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NAVIGATION AND VESSEL INSPECTION CIRCULAR 6-71

Subj: Monitoring carbon monoxide (CO) in ship's cargo spaces

Ref: (a) 46 CFR Parts 35.70-20(d), 78.80-15(c), 78.83-1(b), 97.70-15(c), 97.80-1(b), 146.07-5(d), 146.09-15(e)(3), 146.27-30(d)(1), 146.27-31(d)(1), and 146.27-32(d) (1).

1. Purpose. The purpose of this circular is to present detailed guidance on the proper carbon monoxide monitoring techniques for ship's cargo spaces.
2. Background.
 - a. The use of motor vehicles and mechanized equipment powered by internal combustion engines during loading and unloading operations generates a buildup of carbon monoxide in the cargo spaces. Personnel working in cargo spaces under these conditions may become asphyxiated or may be poisoned due to a high level of carbon monoxide. Prevention of injuries from carbon monoxide can be accomplished by adequate ventilation of the cargo spaces and a carbon monoxide monitoring system which will inform personnel when CO levels reach dangerous concentrations in the air that they are breathing.
 - b. The Coast Guard, being concerned with this question, consulted with industry and government groups that were familiar with the carbon monoxide personnel problem. Included among the groups that the Coast Guard consulted with were the American Conference of Governmental Industrial Hygienists and the Bureau of Labor Standards of the Department of Labor. Evolving from these consultations was a regulatory change to parts of Title 46 of the Code of Federal Regulations outlined in reference (a). The proposed change to the regulations made reference to carbon monoxide monitoring procedures but did not address specific procedures concerning carbon monoxide monitoring.
 - c. It was brought out during the public hearing held in 1969 that there was a question with respect to what CO monitoring procedures were to be used. It became apparent at this time that the development of suitable CO monitoring procedures which could be used by personnel to determine the level of CO in the cargo spaces would require extensive consultations with industrial hygienists and other experts. In view of the delay involved in this undertaking, the Marine Safety Council of the Coast Guard recommended that the amendments as proposed, without the monitoring procedures, be promulgated without delay. It was also decided at this time that the Coast Guard would develop suitable monitoring procedures.

- d. The regulations noted above (ref (a)) include the following:

"The senior deck officer shall see that tests of the carbon monoxide content of the atmosphere are made as frequently as conditions require to insure that dangerous concentrations do not develop."

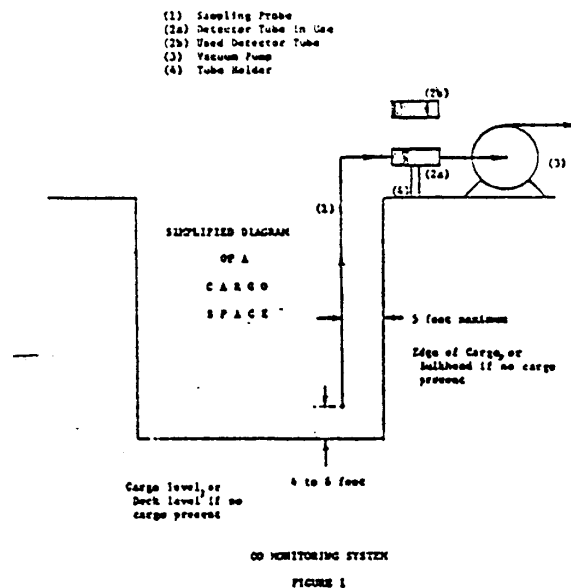
This circular presents suggested guidelines to be used by personnel involved in the carbon monoxide monitoring procedure.

3. Discussion.

- a. The regulations require that the holds and intermediate decks where persons are working shall be maintained at not more than 50 parts per million (0.005%) carbon monoxide as a time-weighted average, and that persons shall be removed from these areas when the carbon monoxide concentration exceeds a concentration of 75 parts per million (0.0075%).
- b. Excursions above 50 ppm but less than 75 ppm would be acceptable provided there are equivalent excursions below the value of 50 ppm.
- c. An integrating CO monitoring system yields a time-weighted average and will show a reading of 50 ppm CO even though there are temporary excursions above 50 ppm CO providing that there are equal excursions below 50 ppm CO. The CO monitoring system which will be discussed in this NVC is an integrating system which meets the intent of the regulations.

4. CO Monitoring System.

- a. The CO monitoring system consists of a CO detector tube, tube holder, sampling probe and vacuum pump which form a portable unit (see Figure 1).



NOTE: This illustration is not drawn to scale. Relative size of CO monitoring equipment (vacuum pump and detector tube holder) is exaggerated in order to simplify presentation.


- b. Assembly of the CO monitoring system is as follows: The sampling probe (1) is connected to one end of the detector tube (2)) the other end of the detector tube is in turn connected to the vacuum pump (3). The detector tube should be firmly supported by the tube holder (4).
- c. The sampling probe should be of material that would not alter the carbon monoxide concentration in the air being sampled, should fit the detector tube snugly so as to prevent leakage, and should be free of cracks or other potential leaks.
- d. The CO detector tube should be a "length of stain" type. Such tubes are manufactured by industrial instrument companies.
- e. The vacuum pump should be capable of drawing air through the sampling probe and the detector tube at the flow rate specified by the manufacturer of the detector tube. The detector tube and pump should be located on the deck above the working area (in order to prevent mechanical damage and make it more accessible to the observer) with the sampling probe extending down to the work area. The sampling probe should be located so that the open end of the probe is drawing in air at the breathing-zone level no farther than five feet from the cargo, or bulkhead if no cargo is present. The probe's location should be representative of the air breathed by the personnel in the space.

5. Operating Procedure of CO Monitoring System.

- a. Operation of the carbon monoxide monitoring system should be continuous. Detector tubes should be changed at least every four hours, or more frequently if the length of the stain extends three quarters of the total length of the indicating material. The length of stain should be measured and recorded periodically to determine if the carbon monoxide concentration in the hold is within prescribed limits. The more often the readings are taken the more assurance there is of a timely detection of a concentration in excess of 75 ppm. The readings should therefore be taken at intervals not to exceed one hour, and when practicable to do so, at intervals not to exceed 15 minutes. Where there is reason to suspect that the concentration has risen above 75 ppm (e.g., from a sudden increase in the periodic sample stain lengths), the current concentration may be obtained by using a fresh detector tube with a standard hand sampler available from the same manufacturer.
- b. If workers are removed from the hold because of a carbon monoxide concentration excursion above the limit of 75 ppm, the monitoring system should be shut off and additional ventilation turned on. "Spot sampling", i.e., samples taken by hand-operated device, should be employed to confirm that the hold has been sufficiently ventilated so that the CO concentration is within prescribed limits.
- c. The length of stain for each detector tube should be measured together with the duration of the tube's use. With this information the time-weighted CO concentration can be determined. As a convenience for this purpose, a chart should be provided that would indicate the CO concentration for various time increments and lengths of stain.
- d. As noted in paragraph 3(b) excursions above 30 ppm but less than 75 ppm are acceptable provided there are equivalent excursions below 50 ppm. It will be necessary therefore to identify, cap and retain used detector tubes until the end of the workshift so that any time-weighted CO concentrations above 50 ppm can be compared with succeeding and following measurements to ensure the total time-weighted average is below 50 ppm.

NAVIGATION AND VESSEL INSPECTION CIRCULAR 6-71

6. Comments. It is anticipated that as comments are received on this NVC improvements will be made concerning the CO monitoring system and appropriate changes will be promulgated.



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Safety

Dist: (SDL 93)

A: None
B: n(45); c(10); q(6); eg(3); bp(1)
C: o(6); m(4); y(2); g(1)
D: i(2); k(1)
E: o(3)
F: ar(1)
List CG-12